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Psychometric Refinement and Structural Analysis of a Process of Change Questionnaire for Weight Control

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PSYCHOMETRIC REFINEMENT AND STRUCTURAL ANALYSIS OF A PROCESS OF CHANGE QUESTIONNAIRE FOR WEIGHT CONTROL

BY

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Abstract

The transtheoretical model of health behavior related-change indicates that people who successfully change a problem behavior move through a series of stages of motivational readiness in their attempts to change. This model has been successfully applied to a wide range of health-related behaviors, and in this study was applied to the area of weight control. The goals of this study were a thorough psychometric examination of a key transtheoretical model construct known as the *processes of change* (POC), the different strategies people use to change their behavior while progressing from one stage of change to the next, and the development of a robust POC measure for weight control.

Questionnaires from 724 participants recruited as part of a larger naturalistic study on smoking behavior were used to ascertain the validity of the process of change construct for weight control. In this questionnaire, 60 items concerned strategies participants used to control or lose weight. Measurement development followed a split-half cross-validation procedure. On the first half of the sample (n=318), principal components analysis revealed moderate deviation from theoretical expectations. Several rounds of reevaluation of theoretical fit, using structural equation models (SEM), and concomitant item evaluation, using Cronbach's coefficient Alpha and SEM modification indices to inform decision making, resulted in a 34 item measure reflecting the 12 processes of change.

After arriving at a more parsimonious measure in the first half of analysis, confirmatory analysis on the second half of the sample (n = 317) was undertaken using structural equation modeling in order to confirm the final solution and refine the

theoretical model. The final structural model that fit best was a 12 correlated factors model. Also, two hierarchical factors (experiential and behavioral) were found. These results are similar to findings for POC models established for other problem behaviors. Construct validity of the revised instrument was established via a series of stage by process analyses which revealed that particular weight control POC are utilized at specific stages of change, in line with theoretical expectations. These analyses also indicated that this instrument is applicable for individuals in all stages of change for weight control.

Thus, this study accomplished two goals: development of a shortened process of change instrument for weight control that meets rigorous psychometric standards, and theoretical refinement of the process of change model for this important content area. Given that, this study has positive implications for both professional and public health interventions on weight control. Since particular weight control POC are utilized at specific stages of change, interventions can be developed for individuals in all stages of change for weight control. The revised POC instrument can identify the strategies individuals are currently using in their efforts to control their weight, and when used in conjunction with expert system technology, can be used to give feedback to help individuals move efficiently through the stages. Such interventions employing the POC for weight control can thus maximize efforts towards successful weight control.

Acknowledgment

This study is akin to a factor analysis of my life at this timepoint. If I analyzed what contributed to my successfully completing this project, I think the efforts and caring of several important people in my life would group into a 3-factor solution. Those factors would be faith, time, and support. I'll start with the person who would have the highest loadings on these factors. I feel much gratitude towards Joe Rossi, my major professor, Sushi Samurai, who helped seed the idea for a project that would meet my goals not only of pursuing something of interest, but teach me valuable lessons in the practice of science. Joe gave me the most precious gift one can give a graduate student - time. He gave me the time to work on this project without demanding too much else of me. Joe also gave me much support, helping me learn statistical techniques, role modeling how to think like a researcher, teaching the most fun advanced statistical class I've had yet, and most importantly, riding the waves of my dedication during the beautiful days of the summer of '96 instead of riding the surf. And most important, he had faith in me.

The next highest loadings belong to my friend Ernie. With much caring, smittenness, and often grace, Ernie gave me a perspective on my achievements that I never had before. He offered encouragement and breaks from analyzing data that helped to revitalize me. Swimming across the hidden pond that was tucked into woods behind his house refreshed both my body and my psyche. These and other memories we shared will help me remember the summer of '96 not only as the summer that I busted to move on my master's, but the summer that I started to rediscover softness.

Mmmm. I still see some high .60's and .70's... looks like these loadings would belong to my buddy Mary DeGroot. Mary and I became "Masters Allies" sometime way back when, and through our second year we met regularly about our masters projects, plodding our way and really supporting each other as two strong women need to do. Having someone in my class, in my world at school, whom I can call a "friend" in a true sense of the word, has really had been great, and I have a lot of respect for Mary's wonderful thinking and intelligence.

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Preface

This thesis is part of a line of research based on the Transtheoretical Model of behavior change and is in manuscript format.

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Introduction

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Prevalence of obesity

The prevalence of obesity is increasing in the United States, especially among women. Indeed, the mean body weight of U.S. adults has increased by almost 8 pounds since 1979. Thirty-two million women and twenty-six million men are currently overweight (Kuczmarski, Flegal, Campbell, & Johnson, 1994). Approximately one third of all American adults currently weigh at least 20 percent more than a standardized weight as defined by 1990 U.S. weight guidelines. Compared to earlier guidelines, these weight standards have also increased and are up to 20 pounds higher for some heights (Kuczmarski et al., 1994).

Since indices reported in obesity studies are somewhat esoteric, some explanation seems necessary before further discussion. The National Institutes of Health recommends the use of body mass index (BMI), which is considered an excellent, practical indicator of body fat (NIH, 1985; Kraemer, Berkowitz, & Hammer, 1990). BMI is an individual's weight in kilograms divided by the square of height in meters. Relating BMI to adjectival descriptions proposed by Stunkard (1984, cited in Clark et al., 1994) and established weight guidelines may clarify meanings for the non-clinician. Using guidelines, current weight may be expressed as a percentage of desirable weight. For example, according to 1983 Metropolitan Life guidelines, a BMI of 27 equates to 120% of recommended body weight. Thus, individuals 20 to 40% overweight are classified as mildly obese (equivalent

to BMI 27 - 31.9), those 41 to 100% overweight as moderately obese, and those over 100% overweight as severely obese (these two latter equivalent to BMI $\geq$ 32).

Consequences of obesity

High blood pressure, high serum cholesterol, and non-insulin dependent diabetes are well established adverse effects of obesity (Manson et al., 1995), but obesity has other serious consequences as well. Severe obesity is unambiguously associated with increased mortality from all causes (Manson et al.). Recent research indicates that among Americans, even mildly overweight individuals are at increased risk for cardiovascular diseases and cancer (Manson et al.). Increased mortality occurs with adult weight gain of 22 pounds or more, rising sharply when BMI exceeds just over 27 (Byers, 1995). This makes sense considering that high blood pressure, high cholesterol, and diabetes are risk factors associated with cardiovascular disease. Treatment is almost always recommended for obesity since it is such a serious health risk factor (Clark et al., 1994). Indeed, the National Institutes of Health recommend weight reduction for all individuals 20% or more above their corresponding acutuarial standardized weight (NIH, 1985).

Problems with current solutions to weight control

Attempts at weight loss and weight control are often unsuccessful solutions to the problem of obesity. Weight control, like smoking cessation, is difficult to achieve (Rossi, 1995). This difficulty is amplified by the frequency and necessity of eating. Most social activities include food, further highlighting the fact that weight control is a continuous event. Moreover, it is not a single, discrete behavior.

Most individuals initiate health-related behavior changes on their own (Cowen, 1982; Shapiro et al., 1984). For weight loss, self-change attempts at dieting are most commonly reported (Williamson et al., 1992). In the U.S., approximately 40% of women and 25% of men are currently trying to lose weight (Williamson et al., 1992). Further, data from two major epidemiological surveys indicated that among individuals overweight at least one time during their life, 60% of men and over 85% of women attempted to lose weight through dieting, although only about one-third reported that they had successfully reduced (Jefferey, 1984).

Even with professional treatment, relapse is common and, in fact, is a serious problem for all obesity treatment approaches (DePue et al., 1995). Most participants in professional interventions have regained some weight by follow-up (Clark et al., 1994). Currently popular intervention approaches, such as weight control programs based at the work site, are also not immune from recidivism. As reviewed by Prochaska (1992), most results of work site interventions are also characterized by high rates of attrition and moderately low rates of weight loss and maintenance.

Relapse may be influenced by a factor which many intervention programs do not take into account - the degree to which an individual is motivated and ready to change their behavior. Since the concept of motivational readiness was first advanced, several models of health behavior change have included the concept, including relapse prevention, motivational interviewing, and the transtheoretical model (for review, see Rossi, 1995).

The transtheoretical model has sparked an abundant line of research strongly indicating that people who successfully change a problem behavior move through a series

of steps, or stages of readiness, in their attempts to change. These stages of change hold true both for people changing on their own or those changing in the context of professional interventions. Most importantly, in marked contrast to other models of behavior change, the transtheoretical model acknowledges that all stages of readiness are important steps in the change process and that the early stages of change are quite important.

The majority of existing interventions for weight control are similar to interventions designed for other potentially addictive behaviors, such as smoking, in that they are tailored towards individuals who are currently ready to take action to change their behavior. These include commercial programs such as Weight Watchers, self-help programs such as Overeaters Anonymous, and professional programs offered by health care providers. Research using the transtheoretical model's core concept, the stages of change, has shown that the vast majority of individuals trying to change their behavior are either not ready for action or are making preliminary efforts towards getting ready to change in the near future. In the area of smoking cessation, for example, Velicer et al. (1995) found that among three samples totaling nearly 19,000 smokers, approximately 40% of individuals were not thinking about changing their behavior in the future, 40% were thinking about changing in the next six months, and only 20% of individuals were actually getting ready to change their smoking behavior in the next month.

Preliminary efforts applying the transtheoretical model to the area of weight control mirror this finding. In Rossi's (1995) study of over 14,000 members of an HMO, almost 40% of individuals with a BMI over 25 had not even attempted to lose weight in

the past 6 months. In addition, more than half of the sample (51.7%) had no plans of attempting to lose weight in the following months. Action-oriented strategies fail, therefore, because they are simply not relevant to the majority of individuals who are at earlier stages of change. By defining success with "bottom line" criteria, i.e. reaching a standardized weight, action-oriented programs ignore the early, necessary stages of change and miss opportunities to help individuals move closer towards changing their behavior.

A more effective solution

The stages of change model

The transtheoretical model of behavior change, also known as the stages of change model, has been widely used in a variety of health promotion interventions. These interventions have covered a broad range of health-related behaviors, including both addictive behaviors, such as alcohol use, cocaine use, and smoking cessation, and non-addictive behaviors, such as condom use, dietary fat reduction, exercise adoption, HIV risk reduction, mammography screening compliance, psychotherapy, and ultraviolet light reduction (DiClemente & Hughes, 1990; DiClemente et al., 1991; Marcus, Rossi, Selby, Niaura, & Abrams, 1992; Martin et al., 1992; Prochaska & DiClemente, 1985; Prochaska, DiClemente, & Norcross, 1992; Rakowski et al., 1992; Redding, 1993; Rosenbloom, 1991; J.S. Rossi, 1990, 1992; S.R. Rossi, Rossi, & Prochaska, 1990). Currently the model is being applied in several interventions simultaneously targeting multiple risk

behaviors, such as a recently launched longitudinal study intervening on three common risk behaviors (sun exposure, dietary fat, and smoking).

Where people are in their change attempt - the stages of change

In over 15 years of theoretical and intervention research based on the transtheoretical model, common principles of change have been found that account for how people succeed and fail in their attempts to modify problem behaviors. The core organizing principle is the stages of change construct. The model posits that people trying to change a behavior do so via a series of five stages which reflect varying degrees of motivational readiness. The five stages of change are precontemplation (not intending to make a change), contemplation (considering a change in the next six months), preparation (getting ready to change in the next month), action (currently trying to change), and maintenance (maintaining the change over time).

This dynamic model asserts that change is a cyclical, not a linear, process. This takes into account the several attempts at behavior change that the majority of individuals make before attaining their goal (Prochaska et al., 1992; Prochaska, DiClemente, & Norcross, 1992). For this reason, relapse is considered part of the cycle of change and is used to help individuals learn from previous change attempts.

How people change - the processes of change

Another well-established construct of this model is the processes of change (POC), which considers the different strategies people use as they progress through the stages of change (Prochaska & DiClemente, 1983). For successful behavior change, specific processes of change are emphasized at each stage. Depending on the specific behavior

evaluated, ten processes are consistently found common to most behaviors (Prochaska & DiClemente, 1985). Sometimes, specific content areas warrant unique processes. Two such additional processes of change which have been posited for weight control are Interpersonal Systems Control and Substance Use. Descriptions for all are provided in Table 1.

An individual's progress from one stage of change to the next is mediated by the appropriate processes of change for each stage (Prochaska et al., 1992). For example, the processes people use to move from precontemplation to contemplation are different from the processes used in moving from contemplation to action. The processes of change have been conceptualized as two higher order factors: an experiential factor, which subsumes processes that are more cognitive and/or affective in nature, and a behavioral factor, which subsumes the more action-related processes (see Table 1). Prochaska et al. (1988) note that the use of experiential processes tends to peak in earlier stages of change and the use of behavioral processes tend to peak in the later stages. In the area of smoking cessation behavior change, for example, experiential processes tend to peak in the contemplation and preparation stages, whereas behavioral processes tend to peak in the action stage, and Precontemplators use the POC least of all (DiClemente et al., 1991; Prochaska & DiClemente, 1983; Prochaska, Velicer, Guadagnoli, Rossi, & DiClemente, 1991).

Continued application of the transtheoretical model to new content areas continues to clarify which specific processes by stage vary within this trend. For instance, Marcus et al.'s (1992) application of the transtheoretical model to the area of exercise adoption

showed that the use of experiential processes peaked in the action stage, as contrasted to the preparation stage as in smoking cessation. It is expected that this pattern of results will vary slightly by problem behavior.

Several years ago, preliminary steps were taken to apply the transtheoretical model to the area of weight control. This study picked up from these efforts and concentrated heavily on psychometric refinement of a Process of Change questionnaire for weight control. As such, the focus of this study was the development and evaluation of a shortened POC instrument and the theoretical refinement of a process of change theoretical model. These ends were achieved through a series of exploratory and confirmatory analyses conducted in the instrument development portion of the study, and validated via a final set of analyses that assessed sex-related differences and established construct validity.

Method

Participants

Participants were 724 volunteer adults recruited as part of a naturalistic, longitudinal study of smoking behavior. Data assessing weight control history, attitudes, and behavioral efforts and intentions were collected at 18 months follow-up. Participants' average BMI score was 24. Relating this to expressions of current weight as a percentage of goal weight, this indicates that, on average, participants in this study were between 100% to 114% of their desired weight. Specifically, their current weight was an average of 15 pounds higher than their desired weight (median 10). Further, the majority

of individuals reported wanting to lose 10 pounds. T-tests revealed that females and males differed significantly on various weight variables. See Table 2 for a comparison of various weight variables by sex.

Participants were deleted from the study if their data records were missing all POC information (n=58) and/or if they indicated an interest in gaining weight (n=38). Further, only adult participants (age 18 and over) were permitted to be in the study. These selection procedures resulted in a final sample size of 635 participants. Demographic data indicated that this subject pool was comprised primarily of white (96%), middle-age (mean age = 40, median = 37), and middle-class adults (median annual income between $10,000 and $15,000 in 1982 dollars). Further, the individuals comprising the sample were predominantly female (67.9%), married (58%), and the majority (80%) had some college education (see Table 3).

Measures

Typical demographic items were collected along with some descriptive information about weight history and weight control intentions.

Staging

Participants were asked a series of questions to determine their stage of change regarding weight control. The five questions ascertained past and present attempts to lose weight as well as current goals and plans about weight control. The response format

varied from dichotomous 'Yes-No' choices to answers with up to six different qualitative responses.

Processes of Change

The Process of Change questionnaire for weight control was a 60-item Likert format inventory designed to measure the strategies used by individuals attempting to lose or control weight. It was adapted for weight control from the smoking POC questionnaire, which was a 40-item inventory with a Likert format (Prochaska, Velicer, DiClemente, and Fava, 1988). Participants responded to each item on a 5-point scale of current frequency of use (i.e., 1 = never, 3 = occasionally, 5 = repeatedly). The original 60 items are provided in Table 4.

Procedure

The data used for this project was culled from a 1980 naturalistic, longitudinal study of smoking behavior conducted from 1980-1982. The recruited sample consisted of 960 adults from Rhode Island and Texas who volunteered in response to newspaper articles and ads. Participants were paid $4.00 for completing a questionnaire every 6 months over a 2-year period. After the initial assessment (baseline), follow-up questionnaires assessing smoking habits, attitudes, and intentions were mailed to all participants every six months, thus compromising five rounds of data collection. At Round 4 (18 month timepoint), participants also completed a process of change questionnaire for weight control, a brief weight history questionnaire, and a subset of items about weight control behaviors and attitudes. The present study used Round 4 data,

initially comprised of 724 observations. This smaller number of participants is reflective of the natural attrition, approximately less than 10% per year, that occurs in longitudinal studies. No interventions were employed during the study.

Initial weight control strategy items used for data collection were generated based on definitions of the different processes of change. Most items were adapted and revised from existing measures used for smoking cessation (Prochaska et al., 1988). Content validity was originally established in 1982 for weight control by having several raters experienced with the transtheoretical model classify items according to conceptual definitions of the constructs.

Results

This study proceeded in a sequence of analyses which will be described in order. To begin, all participants were staged into one of five stages of change. Next, scale development proceeded using a split-half cross validation procedure. Then, alternative conceptualizations of a process of change theoretical model were tested. Lastly, construct validity of the revised instrument was established via a series of stage by process analyses that included sex as a variable in order to assess the impact of sex-related differences.

Staging

The weight history and weight control behavior items proved to be somewhat problematic for staging weight control; the five items used to reveal stage were part of an

unrefined algorithm from the original 1982 survey. Items included in the original survey did not tap specific time points now routinely included in refined stage algorithms. Part of the solution was to stage participants in the first four stages of change if they indicated that the difference between their current weight and their desired weight was greater than zero, and/or that they wanted to lose weight, and/or their BMI was over 27 (translating into over 120% of desired weight). Using these restrictive staging criteria excluded a substantial portion of participants, (n=210; 33% of total sample), from a subset of analyses later in the study that included stage as a variable. Theoretically, however, it made sense to include participants in analyses in which stage was a variable only if they seemed to want to lose weight or had a higher weight than desired. This problem was likewise encountered by Norcross, Prochaska, & DiClemente (1995) in a similar study in which they excluded 32% of their sample (n=193) from analyses in which stage was a variable.

The remaining participants were classified into one of five stages of change. Individuals were classified as Precontemplators if they were not considering losing weight in the next 6 months. Contemplators included individuals who intended to lose weight in the next 6 months. Preparers included individuals who, although they had not been actively trying to lose weight in the last month, had attempted to lose weight in the previous six months and were considering trying to do so again. Action-staged individuals had been actively trying to lose weight in the past month and were intending to keep up the effort to lose weight. Lastly, Maintainers included those participants who were no longer trying to lose weight and had maintained their current weight or a previous weight

loss for more than 6 months. The majority of participants were in the Contemplation (29.9%, n=127) and Action stages of change (28.9%, n=123; see Table 5).

One weight intention item questioned participants about their desired weight or goal weight using the phrase "ideal" weight. However, use of the term "ideal" is problematic: "ideal" weights are based on actuarial standardized weights, which cannot be uniformly applied since they do not take into account muscle mass and frame size (ie. there is no one weight that is *right* for all 5 foot females). Thus, subsequent discussion of this item will defer to the more accurate terms "desirable" or "goal" weight.

Questionnaire Development

Scale development of the process of change questionnaire for weight control followed the sequential methods described by Jackson (1970) and Comrey (1988). Following these methods, the instrument development portion of this study will be described in three parts: item analyses, exploratory analyses, and confirmatory analyses.

Item analyses

This study began by re-establishing content validity with more precise definitions afforded by numerous studies conducted after 1980. The items were coded according to convergent judgments from five masters-level and five doctoral-level judges considered authorities on the transtheoretical model.

Initial item analysis based on examination of the distributions of the 60 POC items revealed 15 items with skewed distributions, mainly for certain processes of change

(substance use and stimulus control). This pattern of distributions was not problematic, however, since prior research has established these types of strategies are infrequently used by people trying to change health-related behaviors on their own. Several of these items were not expected to load highly on any factor and thus were included in initial factor analyses of the original 60 items. Next, social desirability response distortion was assessed by computing the correlation coefficient of the weight control POC responses with a 20-item social desirability scale embedded in the Round 2 questionnaire. Only one item revealed moderate social desirability response bias, as evidenced a coefficient of (-31); however, this item was not among those chosen for the final solution.

Exploratory analyses

The measure development part of this study was conducted using a split-half procedure in which the sample was randomly divided in half. The first half of the sample (Sample 1 n = 318) was used for exploratory analyses using factor analytic techniques to reveal the meaning and quantity of latent variables underlying a set of items. To begin, a 60 x 60 matrix of item correlations was created. A series of principal components analyses (PCA) were then conducted to determine both the factor structure of the POC questionnaire and the number of factors (components) to retain. The meaning of extracted solutions was articulated by using factor rotation, which facilitates interpretation by providing a clearer conceptual picture of the nature of the latent variables underlying the set of items (DeVellis, 1991). Because processes of change in other content areas have been found to be correlated and correlations between processes of change for weight control were evident, oblique rotation was utilized since it allows for redundancy. The

number of factors to retain was based on statistical grounds using an improved procedure (Lautenschlager, 1989) to implement Horn's (1965) parallel analysis, which has been well supported in the literature (Zwick & Velicer, 1986).

PCA is best used to find empirical factor solutions, not theoretical ones. Not surprisingly, the results of the PCAs deviated from theoretical expectations. Initially, PCA suggested a six component solution (accounting for 57.8% of the variance) due to the merging of several factors with complex items. Imposing solutions more in line with theoretical expectations resulted in solutions which revealed slight deviations from process of change factor solutions previously established for other content areas. An item was retained on a factor if it loaded at .50 or greater on the target component and it did not load higher than .30 on any other component. Ten, eleven, and twelve factor solutions accounted for respectively 66.5%, 68.1%, and 69.6% of the variance in the 60 POC items. For the most part, factors revealed by the series of PCA analyses were "pure" (non-complex) and, when not, represented the merging of process factors that were highly correlated due to complex items. Item examination revealed complexity was due to items having either similar wording or meaning. Because one goal of factor analysis is to extract pure factors, complex items were marked for possible deletion pending other evaluative evidence.

Coefficient Alpha (DeVellis, 1991) was also used to help inform decisions about item deletion. Alpha reflects the degree of internal consistency (scale homogeneity) for each separate process of change subscale, and values above .70 are considered acceptable (Nunnally, 1978). Corrected item-total correlations were computed for each subscale,

which indicated how each item correlated with all the remaining items for that subscale. This information helped determine which items substantially reduced a scale's internal consistency.

Next, a series of structural equation modeling analyses (SEM) using the LISREL 7 structural modeling computer program (Jöreskog & Sörbom, 1989) were conducted to improve upon the empirical solution suggested by the PCA analyses. Since SEM is based on theory, a twelve factor model solution, in line with theoretical solutions established for other content areas, was imposed on the same 60 x 60 matrix of item correlations. Several items with low loadings on their target factor were deleted. Decisions to delete further items were made by examining modification indices and normalized residuals, which revealed complex items and poorly functioning items. This process is known as a restricted specification search in which only theoretically meaningful modifications were permitted (MacCallum, 1986; Silva & MacCallum 1988). After items were deleted on empirical bases, additional items were eliminated by evaluating breadth of construct for each factor subscale.

Structural equation measurement models were compared with maximum likelihood factor analyses using LISREL 7. Evaluation of alternative models requires an assessment of the model's overall fit to the data (McDonald & Marsh, 1990). Four indices of fit were computed and compared to determine goodness-of-fit, as recommended by Marsh, Balla, and McDonald (1988).

A short description of fit indices will help explicate the results of the SEM analyses for the exploratory phase of this study, although real critical issues of fit need only be

addressed in the confirmatory phase. The maximum likelihood χ^2 statistic is an absolute measure of fit (no reference is made to a null model) and, since it is highly dependent on sample size and item distributions, was used only as a basis for comparison between models. The Root Mean Square Residual (RMSR) is another absolute index and is a measure of the non-fit of a model (Jöreskog & Sörbom, 1989). The smaller the residuals, the smaller the difference between the reconstructed matrix and the original matrix, and the better the model fit. For these absolute indices (χ^2 , RMSR), lower values indicate better fit with zero representing perfect model fit to the data. For RMSR, a value of .06 or less is considered an acceptable measure of fit, while χ^2 is evaluated based on degrees of freedom and p-values.

The Tucker-Lewis non-normed fit index (TLI; Tucker & Lewis, 1973) and the comparative fit index (CFI; Bentler, 1990) are both indices of relative fit as compared to the null model. Higher values indicate better fit for the relative indices (TLI, CFI), with "1.0" being a perfect fit and "0" indicating a lack of fit. Values of .90 are generally considered an excellent model fit while values less than .80 indicate the need for further improvement of model specifications.

The four fit indices were computed for the initial 12 correlated factors model based on 60 items and the final 12 correlated factors model based on 34 items. The initial model provided a poor fit to the data across all measures of model adequacy, χ^2 (1644) = 4297.63, RMSR = .092. A null model failed to converge so TLI and CFI fit indices could not be computed; however, a goodness of fit index could be computed and although not as psychometrically sound as the TLI or CFI indices, it also indicated a poor fit to the

data, GFI = .678. Compared to the initial model, the 12 correlated factors model based on 34 items provided the best fit to the data across all measures of model adequacy, χ^2 (462) = 842.78, RMSR = .053. Relative fit indices for this model indicate that these specifications provided excellent model fit, (TLI = .932 and CFI = .944).

These procedures ultimately reduced the number of items from 60 to 34. This resulted in 3 items representing each of the 12 processes of change except for Social Liberation and Substance Use, which were each represented by two items. Table 6 lists internal consistency (alpha) coefficients for each of the 12 process subscales, and Table 7 lists their means, standard deviations, and skewness and kurtosis values.

Confirmatory Analyses

The second half of the sample (Sample 2 n=317) was used for confirmatory analyses, consisting of cross-validation and model testing of the factor structure delineated in the exploratory phase on Sample 1. At this point, SEM analyses confirming the 34-item, 12 factor solution were conducted on a 60 x 60 item correlation matrix using data from Sample 2. As hypothesized, a twelve component solution was optimal. Alpha coefficients were recomputed for each of the process subscales and are compared in Table 6 with those computed for Sample 1. Results from Sample 2 are highly similar to those based on Sample 1 and provide further evidence for the cross-validation of the POC questionnaire for weight control.

The final solution corresponds to the ten common processes of change consistently identified for a range of health behaviors by Prochaska et al. (1985) and confirms the use of two processes specifically posited for weight control - Interpersonal Systems Control

and Substance Use. Correspondence of the factor analytic solution to the hypothesized solution constituted evidence of factorial validity.

To avoid confirmation bias, and as a further test of the adequacy of the structural factor model derived from the exploratory analyses in the first phase, several alternative measurement models representing different conceptualizations of the factor structure of the POC questionnaire were evaluated to see which one best describes the data.

1. *Null model.* This simplest possible model suggests that there are no latent factors underlying the process of change and that all POC questionnaire items are completely independent. This model is not meant as a serious representation of the data but rather provides a baseline against which other models are compared.

2. *One-factor model.* This model proposes the existence of a single general process-of-change factor for weight control. Support for this model would suggest that individuals do not differentiate among processes of change in their attempts to control weight.

3. *Two-factor model.* As discussed, the processes of change for other content areas have been conceptualized as two higher order factors representing experiential and behavioral strategies. It was expected that these two higher order factors would be established for weight control as well, although not providing the best fit to the data. Support for this model would suggest that individuals differentiate among processes of change only at the level of these two higher factors.

4. *Twelve-uncorrelated-factors model.* This model proposes that the processes are best represented as independent dimensions of change. Support for this model would suggest

that individuals are able to discriminate among the 12 processes of change and that the processes are best represented as independent (uncorrelated) dimensions of change.

5. *Twelve-correlated-factors model.* This model, like the preceding one, proposes that there are 12 independent dimensions of change but allows the 12 processes of change to be correlated. Support for this model would suggest that individuals are able to discriminate among the 12 processes of change while still using similar types of processes (i.e., experiential processes) more at different stages of change. Based on results from previous studies, this model was considered the most plausible.

Measurement models were compared with maximum likelihood confirmatory factor analyses using LISREL 7. The indices of fit described in the exploratory analyses were computed for the five structural models and compared to determine goodness-of-fit, as recommended by Marsh, Balla, and McDonald (1988). Again, for the absolute fit indices (χ^2 , RMSR), lower values (.06 or lower) indicate better fit and for the relative indices (TLI, CFI), higher values indicate better fit (.90 or higher considered excellent fit).

The four fit indices computed for each model are compared in Table 8. As hypothesized, the 12-correlated factors model provided the best fit to the data across all measures of model adequacy, χ^2 (463) = 1030.36, RMSR = .053. Relative fit indices for this model indicate that these specifications provided excellent model fit, (TLI = .903 and CFI = .920). A chi-square difference test was performed in order to test whether significant differences existed between this model and the second closest fitting model (12 uncorrelated factors). Results indicated that the twelve correlated factors model fit the

data significantly better than the uncorrelated factors model, χ^2 difference =1658.28, *df* difference = 66, $p < .001$. Correlations among the processes ranged from .072 to .78, with an average correlation among processes of .454 (median .23; see Table 9). The confirmed 34 item solution and maximum likelihood item factor loadings by sample are given in Table 10.

Hierarchical Model Testing

When correlated factors exist in structural model solutions, they imply the existence of higher order factors. Thus, a series of SEM analyses were conducted testing the fit of hierarchical models designed to evaluate the existence of two higher order factors previously established for other content areas. These higher, or second order factors, group the 12 individual processes into experiential and behavioral strategies of change as previously discussed. The success of the 12 correlated factors model in this study suggested that the processes of change for weight control may be organized hierarchically as well. Based on data from the full sample, three hierarchical models were compared using the 12 x 12 matrix of maximum likelihood factor correlations.

1. *One hierarchical factor model.* This model expresses the correlations among the 12 processes of change as a single hierarchical factor that represents a general tendency to use the processes of change for weight control, while still representing each as an independent dimension of change.

2. *Two uncorrelated hierarchical factors model.* As with the above model, the distinction among the processes is maintained. However, the two higher order factors are posited to be separate dimensions of change.

3. *Two correlated hierarchical factors model.* This model, considered the most plausible, both preserves the distinctions between independent processes while capturing both dimensions of change strategies and allows these higher order dimensions to be correlated. Results obtained from other studies on smoking cessation and exercise adoption support this conceptualization.

The three model fit indices are compared in Table 11. Both the one hierarchical factor and the correlated two hierarchical factor models provided excellent fit to the data. A chi-square difference test was performed in order to test whether significant differences existed between these models. Results indicated that the two correlated hierarchical factors model fit the data significantly better than the one hierarchical factor model, χ^2 difference = 51.19, *df* difference = 1, $p < .001$.

Although the non-hierarchical 12 correlated factors model tested in the confirmatory phase fit the data best out of all structural models tested, relative fit indices for the best fitting hierarchical model (two correlated hierarchical factors) indicate that these specifications provided excellent model fit, TLI = .904 and CFI = .912, see Figure 1. The proportion of variance accounted for each subscale by its respective higher order factor ranged from 10% to 85%: these proportions are listed in Table 12. Conceptually, this hierarchical model for weight control processes of change is similar to hierarchical process of change theoretical models established for other content areas.

Construct Validity Analyses

Since the processes of change are used differentially by participants in different stages of change, scores on derived process scales are anticipated to vary with stage in a theoretically predictable pattern. Prior research has established that Precontemplators use the processes of change least of all, and that process use increases through the stages, usually peaking in Preparation or Action. Specific to the peak stage of process use, it was expected for this study that results would be similar to those found in the area of exercise adoption in which the use of both behavioral and experiential processes of change was highest for individuals in the action stage. To ascertain whether these findings hold true in the area of weight control using the revised instrument, a comprehensive set of stage by process MANOVA analyses were conducted. Construct validity can be established by finding statistical similarity with participants' mean scores and patterns of process use in this study with established findings.

However, since this sample was disproportionately made up of more females than males, sex differences in stage distribution first needed to be ascertained. This was done using a chi square analysis with sex and stage as the two categorical variables. Females were less likely than males to be in the earlier stages of change (35.8% vs. 45.6%, for Precontemplation and Contemplation stages combined), and more likely to be in later stages of change (53.6% vs. 45.6%, for Action or Maintenance stages combined), χ^2 (4) = 10.26, $p < .05$. Since differences existed in the way women and men were distributed

through the stages, sex needed to be included in the MANOVA analyses to separate from stage effects any possible sex effects.

Thus, two-way MANOVAs were conducted using stage of weight control (P = Precontemplation, C = Contemplation, D = Preparation, A= Action, M = Maintenance) and sex as the two independent variables. The Dependent variables were the processes of change, tested alternatively at the level of the 12 individual processes and then at the level of the two hierarchical factors. To begin these analyses, scaled scores using the T distribution (M = 50, SD = 10) were computed for both the 12 POC subscales and the two higher order factors. There were 396 participants included in these analyses.

First, results were evaluated to ascertain if process of change use for weight control varied by sex across stages of change. Overall, there was a significant interaction of stage by sex at the level of the 12 individual processes, as indicated by Wilks' criterion, $F(48,1447) = 1.55$, $p < .01$. Follow-up univariate tests looking at specific stage by sex interactions, however, revealed no significant interactions by POC subscale. When the patterns of POC use by sex across stages at the level of the two hierarchical factors were examined, Wilks criterion indicated no significant interaction of stage by sex, $F(8,770) = 1.025$, $p > .05$. As hypothesized, this result indicates that, regardless of stage, men and women have the same overall patterns of POC use at the level of these two higher order factors. These two results indicate that differences in weight control process of change use between men and women exist independent of their stage of change.

Next, main effects for both sex and stage were examined, and effect sizes reflecting the total proportion of variance accounted for were computed. No established criteria

exists for making relative evaluations of multivariate effect sizes, although univariate effect sizes were evaluated according to Cohen's (1977) widely accepted criteria. This criteria considers univariate (the effect of one IV on one DV) proportions of variance which account for .01 of the total variance "small effects", those that account for .06 of the total variance "medium effects," and those accounting for .13 or greater "large effects."

At the level of the 12 individual processes, MANOVA indicated that a main effect resulted for sex as indicated by Wilks' criterion, $\underline{F}$ (12, 375) = 9.31, $\underline{p}$ <.001. Overall, sex accounted for 23% of the variance (multivariate eta-squared, or η^2) in participants scores at this first order level of process conceptualization. Follow-up univariate Anovas conducted for each of the 12 processes of change revealed statistically significant differences ($\underline{p}$s <.001) in process use between the sexes for eight out of twelve process. Regardless of stage, women had statistically significantly higher mean scaled scores than men on eight out of twelve processes. The follow-up F-tests indicated that the univariate effects of sex on individual process use were generally small to medium, with proportions of variance accounted for per process ranging from less than .01 to .11 (median = .065). Mean scaled scores and univariate eta-squared values for each process by sex are reported in Table 13.

MANOVA results also revealed a main effect for sex at the level of the two higher order factors, $\underline{F}$ (2,385 = 15.268, $\underline{p}$ <.001. Although the main effect for sex was significant, it accounted for only about 7% of the variance between POC scores at this second level of process conceptualization (multivariate η^2 = .0735). Follow-up Anovas revealed medium effect sizes of sex on experiential and behavioral process use (univariate

η^2 = .06 for both). Combined, these results are similar to findings from other studies which have demonstrated that women tend to use the processes of change more frequently than men.

As expected, a main effect for stage at the level of the 12 individual processes was revealed by the MANOVA results, $\underline{F}$ (48,1466) = 5.82, $\underline{p}$ <.001. Overall, stage accounted for 16% of the variance in participants scores at this first order level of process conceptualization (multivariate η^2=.156). Follow-up univariate Anovas conducted for each of the 12 processes of change were all statistically significant ($\underline{p}$s <.05) except Environmental Reevaluation. The univariate effects of stage were generally large, with proportions of variance accounted for ranging from .06 to .37 (median = .15). Table 14 lists mean scaled scores and univariate eta-squared values for each process by stage. Figure 2 shows differences in process use by stage. Combined, these findings are in line with results from previous studies which indicate that an individual's use of a specific process of change is dependent upon their stage of change.

MANOVA results also indicated a main effect for stage at the level of the two higher order factors, $\underline{F}$ (8,770) = 20.991, $\underline{p}$ <.001. The main effect for stage was strong, accounting for 18% of the variance (multivariate η^2=.179). This result indicates that individuals in different stages had differential patterns of POC use at the level of these two higher order factors. As hypothesized, Precontemplators reported the lowest process of change use, while the use of both experiential and behavioral processes peaked in the

action stage (see Figure 3). This result is similar to that found for exercise adoption process of change use by Marcus et al. (1992).

Lastly, all results were checked by adding two demographic variables into the analyses. A series of MANCOVAs were conducted including age and body-mass index (BMI) as covariates and resulted in no essential changes in the reported MANOVA results; for the sake of simplicity, the MANOVA results were used in this study. Taken together, the combined MANOVA results reveal that men and women differ in their weight control process of change use irrespective of stage of change but that stage is a more powerful variable than sex in explaining differential patterns of process use. Participants in later stages of change, as expected, use the processes of change more than those in earlier stages of change. The demonstrated similarity of stage by process results in this study with that of established findings verifies construct validity for the shortened 34-item POC questionnaire.

Discussion

This study refined a process of change theoretical model for weight control. The best conceptualization of the POC for weight control was a twelve-correlated-factor model. This model reflects each process as an independent dimension of change that is part of a group of related strategies of change, similar to other POC models that have been established for other content areas. Further, patterns of process use showed that the processes of change for weight control are organized hierarchically, thus supporting

continued conceptualization of the processes of change into two general dimensions of change strategies.

As has been found across all content areas to which the transtheoretical model has been applied, individuals in the precontemplation stage for weight control had the lowest process of change scores. Similar to findings in the area of exercise adoption, use of both the behavioral and experiential processes for weight control peaked in the action stage. This is in contrast to results from smoking cessation studies which showed that experiential processes for smoking cessation peaked in the preparation stage. Since both weight control and exercise adoption behavior change are focused on acquiring new behaviors, this departure may be due to the difference between acquisition and cessation behaviors. It suggests that successful weight control has more to do with adopting a lifestyle change than stopping certain behaviors. Weight control, unlike smoking cessation, is the result of many behaviors combined uniquely by each individual trying to achieve it. Behaviors like counting calories, dieting, and exercising are likely to be lifelong efforts if weight control is be successful over the long term.

Of note was the high correlation between the two higher order factors in the hierarchical structural models. The correlation between the two factors, .905, was extremely high, a result similar to that found for exercise processes of change (.908). In other content areas, such as smoking cessation, and in a previous weight control study based on community participants in a weight loss program, the correlations between the higher order factors were more moderate (.769 and .766, respectfully). In the present study, even though the overall pattern of process use at this second level of

conceptualization were similar, differences were statistically significant. Thus, it seems that preserving the distinction between the two higher order factors is more useful conceptually than thinking of a general process of change factor which does not further explain overall patterns of POC usage by stage.

This study also established that individuals use twelve distinct change strategies in their efforts to control their weight. These include the ten common processes established for other health-related behaviors as well as two processes additionally posited for weight control: Interpersonal Systems Control and Substance Use. These two processes had been established in preliminary efforts in applying the transtheoretical model to weight control, psychological distress, and smoking cessation.

Results from these early studies revealed that Substance Use was one of the least frequently applied processes for self-changers dealing with these types of problems (Prochaska & DiClemente, 1985). Indeed, Substance Use was the least utilized process of change in the current study. This may be a sin of omission: perhaps this study's participants reported underutilizing this process simply because the items did not specifically mention legal substances that many people use to control their weight: caffeine and most importantly, nicotine. After all, this was a sample of smokers and ex-smokers, and it has been established that cigarette smoking is often used to control weight. Future research should test expanded versions of a Substance Use subscale specifically including items concerning cigarette and caffeine use.

The use of an Interpersonal Systems Control strategy in self-change efforts to control weight was also confirmed in this study. The use of this type of change strategy

has been confirmed in recent transtheoretical model interventions in the areas of dietary fat reduction, condom use, and sun exposure, although its use in smoking cessation has not held up. This may be a difficult strategy to intervene upon for some content areas: most people are not likely to give up friends or avoid them just because their friends engage in the same problem behavior that they are trying to stop. Not everyone who eats chocolate cake or potato chips has a weight problem. In the area of substance abuse, though, this type of strategy is often included in interventions as it makes sense to suggest changing one's circle of friends if they engage in illegal and harmful behavior. Future research will need to determine the usefulness of including this strategy in weight control interventions.

More practically, the goal of a shortened POC instrument for weight control was accomplished. Lengthy measures, such as process of change questionnaires which typically including ten to twelve subscales, heighten the need for balancing psychometric quality while keeping in mind the response burden placed on participants. Designing these measures requires careful item selection so that items measuring the construct capture its breadth within reasonable limits. The revision of the POC for weight control seems successful because the shortened version captures the breadth of each process adequately, meets rigorous psychometric standards, and reduces the response burden.

In fact, the parsimony went a bit beyond expectation; the initial goal was a 36-item version yet the final version contained only 34 items. This was because two of the factors, Substance Use and Social Liberation, were best represented by only two items each. However, these two item solutions empirically represented each process adequately and were able to capture conceptually the essence of these particular change strategies.

Substance Use is such a distinct process that all items tapping this construct had high factor loadings and remained pure through all extracted factor solutions. Further support for a two item solution for Social Liberation was revealed by examining this subscale's coefficient Alpha and inter-item correlations, which indicated that the third item with the next highest loading substantially detracted from internal consistency. Future research should include efforts to test the robustness of these two subscales.

Factor analytic techniques based on empirical grounds, such as PCA, often reveal solutions that do not merge with theoretical expectations. This was true in this study as well. During the first few rounds of exploratory analyses, before any items were deleted, PCA extracted solutions in which it looked like a separate factor wanted to emerge. This factor, highly correlated with both Stimulus Control and Self Liberation factors, seemed to tap behavioral markers of commitment and was strongly marked by three items: "I count the number of calories I eat," "I weigh myself to keep track of my weight," and "I change my diet to help me lose weight." This divergence suggested the existence of a separate process of change called Dieting Behavior.

However, further empirical exploration using structural equation models revealed that these Dieting Behavior items were most highly correlated with Self Liberation items, which traditionally are statements about beliefs in one's ability to change. In SEM analyses, these Dieting Behavior items ended up being too highly correlated with Self Liberation items to emerge as a separate factor. Items finally chosen for Self Liberation were in line with traditional theoretical interpretations and these divergent behavioral items were not included in the final measure. Thus, while PCA is useful for exploring possible

factor solutions, caution must be used in interpreting results that differ from theoretical expectations as these results may reflect item complexity rather than underlying factors. One last note regarding these items: in current applications of the transtheoretical model to various content areas such as dietary fat reduction and sun exposure, items like these are commonly thought of as basic strategies. However, in line with current transtheoretical model findings, these "basic strategies" are more like action criteria and thus seem to be behaviors that delineate the later stages of change rather than behaviors that one uses to move through the stages. Thus, these items may still prove to be useful in future studies doing the necessary refinement of a staging algorithm for weight control.

Of note was the tendency for both item and scale distributions to be skewed for stimulus control-type processes, such as Substance Use, Stimulus Control, and Interpersonal Systems Control. This finding is not without precedent but creates no problem. These types of strategies have in common the use, modification, or avoidance of substances, situations and things, or people to help one change the problem behavior. Results from process of change studies in other content areas usually indicate that these type of change strategies are not frequently used by most individuals.

Differences between the sexes in this study manifested as different proportions of men and women in the stages of change. While men are usually more successful dieters than women, women are more concerned about weight. Perhaps because women are more concerned about their weight, they are more likely to do something about it and thus more likely to be in later stages of change for weight control. Differences between men and women also existed in process of change use at a statistically significant level.

Previous findings from sun exposure and smoking cessation studies suggest that, for some processes, women report higher individual POC use than men, although these differences are relatively small. As expected, regardless of stage, women in this study reported higher POC use than men for most of the processes. These findings suggest that women reap a notable benefit from using the processes of change more than men - this helps them to be in later stages of change compared to men.

This study had two major limitations. The first is that the instrument development began with previously written items adapted from a 1980 smoking process of change questionnaire. As such, items used for this measure do not cover an important dimension of weight control now included in the current theoretical understanding of this content area. Specifically, none of the items covered aspects of exercise as weight control processes of change although nowadays this is a considered a common change strategy for weight control and is often included in weight control interventions. The lack of this dimension in the current instrument is a serious liability that needs to be addressed. The other major limitation was participant demographics: once again, research findings have been established for the white, middle class majority. Reaching out to include more diverse, representative populations is necessary if behavioral change interventions are to be applicable to all.

Other limitations of this study should be noted. This research was based on a cross-sectional sample of participants using self-report data. Future research should determine if the present findings hold up in longitudinal investigations. Also, the participants were predominantly female; even though the processes of change model has

been found to be structurally equivalent for men and women (Rossi and Bellis, 1993), future studies should make an effort to recruit more males. Lastly, evaluation of weight behavior goals and intentions revealed that this sample can further be understood as predominantly individuals interested in weight loss (76%) rather than weight control (24%). More research validating this instrument on individuals interested in weight control needs to be done before these findings can be freely generalized to individuals with either weight goal.

In conclusion, extensive analytical techniques based on two samples established the validity and consistency of the underlying factor structure for a short version of a POC questionnaire for weight control. This provides further evidence for the existence of a processes of change model for weight control. As reflected by the tests for construct validity, this instrument is applicable for individuals in all stages of change for weight control.

Given that, this study has positive implications for professional interventions on weight control. Stage-specific interventions, a prominent advantage of treatment programs based on the transtheoretical model, have been shown to effectively address the needs of the vast majority of individuals in the early stages of behavior change who previously were ignored or unmoved by action-oriented interventions. Matching the strategies that a particular individual uses with their actual degree of motivational readiness has been shown to result in more effective behavior change, leading to higher and more lasting success rates.

Currently, technologically innovative ways of implementing interventions based on complex behavioral change models such as the transtheoretical model are being refined (Velicer et al, 1993). Since particular weight control POC are utilized at specific stages of change, expert system interventions can be developed for individuals in all stages of change for weight control. The POC instrument revised in this study can identify the strategies individuals are currently using, and when used in conjunction with expert system technology, can be used to give feedback to help individuals move efficiently through the stages. Such interventions employing the POC for weight control can thus maximize efforts towards successful weight control. An added advantage of expert system technology is that it can be used to reach vast numbers of individuals with behavioral health problems. Given the increasing use of expert systems technology to implement behavioral health interventions, this study also has implications for public health approaches to weight control.

Table 1 Conceptual Definitions of the Processes of Change

Behavioral Processes	*Strategies of change which are more action-related*
Counterconditioning	is the substitution of alternative behaviors for the problem behavior
Helping Relationships	refers to trust, acceptance, and utilization of the support of caring others while attempting to change
Interpersonal Systems Control	involves both the avoidance of other people who contribute to the problem behavior and association with individuals who help decrease it
Reinforcement Management	refers to how the individual is rewarded by themselves or others for changing their behavior
Self -Liberation	is related to willpower and refers to both an individual's commitment to change and the degree to which they believe they can change
Stimulus Control	is involved with the decreasing occurrence of the problem behavior through control of situations or cues that trigger the behavior
Substance Use	considers the use of substances, such as drugs, medications, and diet aids, used to control weight
Experiential Processes	*Strategies that are primarily cognitive and/or affective in nature*
Consciousness Raising	involves recognition of the problem behavior and efforts made to seek information and gain understanding about the behavior
Dramatic Relief	describes affective aspects of change, and involves a strong emotional reaction to events in the social environment related to the behavior
Environmental Reevaluation	involves consideration and assessment of how the problem behavior impacts the individual's physical and social environments
Self-Reevaluation	concerns emotional and cognitive reappraisals of the costs and benefits of the problem behavior
Social Liberation	concerns awareness, availability, and acceptance of changes in the environment that provide alternative, problem-free life styles

Table 2 Weight Demographics for Total Sample by Sex

	Mean	Std. Dev.	N	p
Current weight				.001
Females	142	28.5	427	
Males	180	27.9	204	
Desired weight				.001
Females	126	15	425	
Males	167	19	204	
Number of pounds wanting to lose				.05
Females	17	20.2	423	
Males	13.2	14.3	202	
BMI				.001
Females	23.8	4.4	426	
Males	25.9	3.8	200	

BMI (by intervals)	N	%
Females		
BMI < 22	176	40.8
BMI 22-26	179	41.5
BMI 27-31	46	10.7
BMI > 32	25	5.8
Males		
BMI < 22	21	10.3
BMI 22-26	118	57.8
BMI 27-31	50	24.5
BMI > 32	15	7.4

Table 3 Demographics for Total Sample

DEMOGRAPHICS	N	%
Sex		
Female	431	67.9
Male	204	32.1
Race		
Caucasian	607	95.7
African American	14	2.2
Asian	4	0.6
Latino	6	0.9
Other	3	0.5
Gross Annual Income (in 1982 dollars)		
Less than $ 5,000	121	21.4
$ 5,000 - $ 9,999	68	12.0
$10,000 - $14,999	131	23.1
$15,000 - $19,999	98	17.3
$20,000 - $24,999	61	10.8
$25,000 - $29,999	27	4.8
$30,000 or more	60	10.6
Marital Status		
Single	126	19.9
Married	367	58.1
Divorced	105	16.6
Separated	21	3.3
Widowed	13	2.1
Education		
Less than 8th grade	12	1.9
Some high school	25	4.0
High school	87	13.9
Some college	242	38.8
College graduate	117	18.8
Postgraduate work	73	11.7
Graduate degree	68	10.9

	Mean	Std. Dev.
Age	39.76	12.2

Table 4 Weight Control Process of Change Items, Original 60 items

POC	Item	
HR	1	Special people in my life accept me whether I lose weight or not.
SR	2	I am the object of discrimination because of my being overweight.
HR	3	I can be open with at least one special person about my experiences with overeating behavior.
CR	4	I read about people who successfully lose weight.
SL	5	I tell myself I can choose to over-eat or not.
CC	6	Instead of eating I engage in some physical activity.
SU	7	I take diet pills to help me lose weight.
SO	8	I notice how low calorie foods are being advertised on television.
CR	9	I recall information people have personally given me on the benefits of losing weight.
CR	10	I think about information from articles and advertisements on how to lose weight.
SR	11	I think about how upset I am when I binge on food.
RM	12	People in my daily life try to make me feel good about losing weight.
SC	13	I change my diet to help me lose weight.
SL	14	I tell myself I am able to lose weight if I want to.
HR	15	I have someone who listens when I need to talk about my losing weight.
CC	16	When I am tempted to overeat, I try to relax.
RM	17	I do something nice for myself in return for not overeating.
SC	18	I remove fattening foods from my home.
SL	19	I tell myself that, if I try hard enough, I can keep from overeating.
SL	20	I make commitments to lose weight.
RM	21	I reward myself when I don't binge on food.
SR	22	Being overweight brings out negative feelings in me.
RM	23	I expect to be rewarded by others if I don't overeat.
SC	24	I keep things around my place of work that remind me not to snack.
SO	25	I find society more supportive of thin people.
SR	26	I get upset when I think about my overeating.
CC	27	I find that doing other things with my hands is a good substitute for eating.
ER	28	I consider the view that my family deserves a slimmer, healthier me.
SU	29	I take some type of medications to help me control my weight.
SC	30	I remove things from my place of work that remind me of eating.
DR	31	Dramatic portrayals of the plight of overweight people affect me emotionally.
DR	32	I react emotionally to warnings about gaining too much weight.
ER	33	I consider the view that overeating could be harmful to world food supplies.
SR	34	I reassess the fact that being content with myself includes changing my overeating habits.
SO	35	I notice that overweight people have a hard time buying attractive clothes.

Weight Control Process of Change Items (Continued)

DR	36	I have fearful feelings about developing heart trouble from being overweight.
SC	37	I put things around my home that remind me not to overeat.
SU	38	I take diet aids to help me lose weight.
SR	39	My dependency on food makes me feel disappointed in myself.
ER	40	I stop to think that overeating is taking more than my share of the world's food supply.
SU	41	I take diet drugs to control my weight.
HR	42	I have someone whom I can count on when I have problems with overeating.
CR	43	I recall information people have personally given me about the harmful effects of my overeating.
CC	44	I do something else instead of eating when I need to relax or deal with tension.
DR	45	Remembering stories about illnesses caused by being overweight upsets me.
CR	46	I recall articles dealing with the problems of losing weight.
SL	47	I experience a sense of freedom when I choose not to overeat.
DR	48	Warnings about health hazards of being overweight move me emotionally.
CC	49	When I am tempted to overeat, I think about something else.
IS	50	I avoid people who encourage overeating.
SC	51	I leave places where people are eating a lot.
HR	52	I feel accepted by others whether I overeat.
SC	53	I count the number of calories I eat.
IS	54	I associate with people who try to help me control my weight.
ER	55	I consider the belief that people who lose weight will help to improve the world.
SO	56	I notice that the world's poor are asserting their right to a greater share of food supplies.
SR	57	I struggle to alter my view of myself as an overweight person.
RM	58	I am rewarded by others when I lose weight.
IS	59	I change personal relationships which contribute to my overeating.
SC	60	I weigh myself to keep track of my weight.

Key

CC	Consciousness Raising	**RM**	Reinforcement Management
CR	Counterconditioning	**SL**	Self -Liberation
DR	Dramatic Relief	**SR**	Self-Reevaluation
ER	Environmental Reevaluation	**SO**	Social Liberation
HR	Helping Relationships	**SC**	Stimulus Control
IS	Interpersonal Systems Control	**SU**	Substance Use

Table 5 Stages of Change for Weight Control, n=635

Stage	N	Percent	Staged Percent
Precontemplation	40	6.3	9.4
Contemplation	127	20.0	29.9
Preparation	42	6.6	9.9
Action	123	19.4	28.9
Maintenance	93	14.6	21.9
Unable to stage	210	33.1	--

Table 6 Coefficient Alpha for final 34-item POC measure, by subscale

	Number of items	1st half of sample (n=284)	2nd half of sample (n=268)	Total sample (n=552)
Experiential process subscales	*14*	*.879*	*.906*	*.893*
CR	3	.832	.862	.849
DR	3	.869	.890	.881
ER	3	.750	.821	.787
SR	3	.872	.90	.885
SO	2	.644	.709	.674
Behavioral process subscales	*20*	*.922*	*.902*	*.914*
CC	3	.825	.765	.796
HR	3	.895	.869	.884
IS	3	.735	.720	.727
RM	3	.831	.812	.822
SC	3	.860	.895	.877
SL	3	.885	.841	.865
SU	2	.929	.958	.945

CC: Consciousness Raising, CR: Counterconditioning, DR: Dramatic Relief, ER: Environmental Reevaluation, HR: Helping Relationships, IS: Interpersonal Systems Control, RM: Reinforcement Management, SC: Stimulus Control, SL: Self Liberation, SO: Social Liberation, SR: Self-Reevaluation, SU: Substance Use

Table 7 Subscale Characteristics for final 34-item POC measure

	Sample 1		*Sample 2*	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**
Experiential process subscales	*2.53*	*0.74*	*2.60*	*0.80*
CR	2.72	1.07	2.89	1.14
DR	2.05	0.96	2.19	1.04
ER	1.45	0.62	1.45	0.68
SR	2.96	1.25	3.05	1.28
SO	3.48	1.07	3.40	1.11
Behavioral process subscales	*2.27*	*0.68*	*2.29*	*0.62*
CC	2.70	0.93	2.66	0.94
HR	3.10	1.26	3.29	1.18
IS	2.00	0.84	2.04	0.86
RM	1.97	0.94	1.95	0.89
SC	1.59	0.80	1.58	0.81
SL	3.25	1.16	3.27	1.07
SU	1.28	0.71	1.30	0.79

CC: Consciousness Raising, CR: Counterconditioning, DR: Dramatic Relief, ER: Environmental Reevaluation, HR: Helping Relationships, IS: Interpersonal Systems Control, RM: Reinforcement Management, SC: Stimulus Control, SL: Self Liberation, SO: Social Liberation, SR: Self-Reevaluation, SU: Substance Use

Table 8 Fit Indices for Weight Control Processes of Change Structural Models

Type of Model	χ^2	*df*	TLI	CFI	RMSR
Null	7650.43	561	--	--	.341
One Factor	4043.54	528	.473	.504	.109
Two Factor	3890.34	528	.496	.526	.108
12 Uncorrelated Factors	2688.64	529	.677	.695	.305
12 Correlated Factors	1030.36	463	.903	.920	.053

Confirmatory SEM on the Second Half of the Sample (N = 317)

Table 9 Maximum Likelihood Correlations among the POC for Weight Control

	CR	DR	ER	SR	SO	CC	HR	IS	RM	SC	SL
DR	.521										
ER	.228	.529									
SR	.750	.542	.254								
SO	.585	.573	.315	.735							
CC	.598	.529	.363	.641	.600						
HR	.426	.256	.075	.407	.333	.394					
IS	.669	.671	.603	.713	.674	.758	.351				
RM	.502	.434	.281	.560	.496	.637	.254	.672			
SC	.494	.480	.463	.473	.442	.525	.117	.752	.555		
SL	.706	.360	.181	.781	.547	.668	.494	.607	.625	.384	
SU	.230	.108	.188	.332	.223	.153	.072	.332	.212	.293	.228

Minimum Value = .072

Maximum Value = .781

Mean = .454

Median = .23

Table 10 Weight Control POC Item Maximum Likelihood Factor Loadings

	Sample 1	Sample 2
Experiential Processes		
Consciousness Raising		
I read about people who successfully lose weight.	.688	.733
I recall information people have personally given me on the benefits of losing weight.	.811	.810
I think about information from articles and advertisements on how to lose weight.	.878	.939
Dramatic Relief		
I have fearful feelings about developing heart trouble from being overweight.	.684	.738
Remembering stories about illnesses caused by being overweight upsets me.	.929	.886
Warnings about health hazards of being overweight move me emotionally.	.889	.914
Environmental Reevaluation		
I consider the view that overeating could be harmful to world food supplies.	.845	.861
I stop to think that overeating is taking more than my share of the world's food supply.	.898	.819
I consider the belief that people who lose weight will help to improve the world.	.438	.700
Self Reevaluation		
I think about how upset I am when I binge on food.	.804	.885
Being overweight brings out negative feelings in me.	.788	.797
I get upset when I think about my overeating.	.937	.916
Social Liberation		
I find society more supportive of thin people.	.745	.713
I notice that overweight people have a hard time buying attractive clothes.	.682	.791
Behavioral Processes		
Counterconditioning		
I find that doing other things with my hands is a good substitute for eating.	.703	.665
I do something else instead of eating when I need to relax or deal with tension.	.675	.650
When I am tempted to overeat, I think about something else.	.929	.808

Weight Control POC Item Factor Loadings by Subscale (continued)

	Sample 1	Sample 2
Helping Relationships		
I can be open with at least one special person about my experiences with overeating behavior.	.765	.728
I have someone who listens when I need to talk about my losing weight.	.924	.926
I have someone whom I can count on when I have problems with overeating.	.876	.851
Interpersonal Systems Control		
I avoid people who encourage overeating.	.672	.734
I associate with people who try to help me control my weight.	.729	.666
I change personal relationships which contribute to my overeating.	.645	.618
Reinforcement Management		
I do something nice for myself in return for not overeating.	.899	.917
I reward myself when I don't binge on food.	.900	.886
I expect to be rewarded by others if I don't overeat.	.598	.559
Self Liberation		
I tell myself I am able to lose weight if I want to.	.802	.717
I tell myself that, if I try hard enough, I can keep from overeating.	.864	.796
I make commitments to lose weight.	.864	.843
Stimulus Control		
I keep things around my place of work that remind me not to snack.	.774	.841
I remove things from my place of work that remind me of eating.	.807	.833
I put things around my home that remind me not to overeat.	.809	.873
Substance Use		
I take some type of medications to help me control my weight.	.956	.958
I take diet aids to help me lose weight.	.904	.958

Sample 1: Exploratory 12 correlated factor structural model on first half, n = 318
Sample 2: Confirmatory 12 correlated factor structural model on second half, n = 317

Table 11 Fit Indices for Weight Control Processes of Change Hierarchical Structural Models

Exploratory SEM on the Total Sample (N = 635)

Type of Model	χ^2	*df*	TLI	CFI	RMSR
1 Higher Order Factor	1772.19	517	.901	.908	.069
2 Uncorrelated Higher Order Factors	2276.94	517	.861	.872	.224
2 Correlated Higher Order Factors	1721.00	516	.904	.912	.069

Table 12 Proportions of Subscale Variance Accounted for by Respective Higher Order Factors

Experiential Processes	
Consciousness Raising	.645
Dramatic Relief	.444
Environmental Reevaluation	.122
Self Reevaluation	.764
Social Liberation	.592
Behavioral Processes	
Counterconditioning	.684
Helping Relationships	.264
Interpersonal Systems Control	.851
Reinforcement Management	.565
Stimulus Control	.514
Self Liberation	.664
Substance Use	.104

Table 13 Mean POC Subscale T Scores, by Sex

Process	*Sex*			*p*	η^2
	FEMALES		MALES		
CR	51.9	>	46.0	.01	.03
DR	50.3		49.3	n.s	--
ER	50.3		49.5	n.s	--
SR	52.7	>	44.1	.001	.11
SO	52.7	>	44.2	.001	.11
CC	52.2	>	45.3	.001	.08
HR	51.5	>	46.7	.01	.03
IS	51.6	>	46.6	.01	.02
RM	51.3		47.3	n.s.	--
SC	51.4	>	47.0	.05	.11
SL	52.3	>	45.0	.001	.05
SU	51.1		47.6	n.s.	--

Table 14 Mean POC Subscale T Scores, by Stage

	Stage					*p*	η^2
	Precontemplation	**Contemplation**	**Preparation**	**Action**	**Maintenance**		
Experiential Processes							
CR	42.08	48.86	51.25	55.30	42.50	.001	.22
DR	44.28	49.85	52.33	53.72	46.07	.001	.10
ER	47.82	48.99	50.81	51.50	50.87	.175	--
SR	41.34	48.16	53.78	54.84	40.78	.001	.27
SO	41.97	48.80	52.28	53.15	45.90	.001	.09
Behavioral Processes							
CC	40.72	49.14	51.83	54.64	44.61	.001	.18
HR	44.83	48.95	51.62	54.88	44.26	.001	.14
IS	42.36	49.01	52.63	54.56	44.19	.001	.17
RM	44.24	48.73	54.11	53.23	44.38	.001	.15
SC	45.78	48.82	51.22	53.39	46.02	.001	.06
SL	40.88	48.94	51.84	56.39	39.37	.001	.37
SU	46.65	48.10	49.62	52.27	47.50	.029	.03

Figure 1 Two Correlated Hierarchical Factors Structural Model

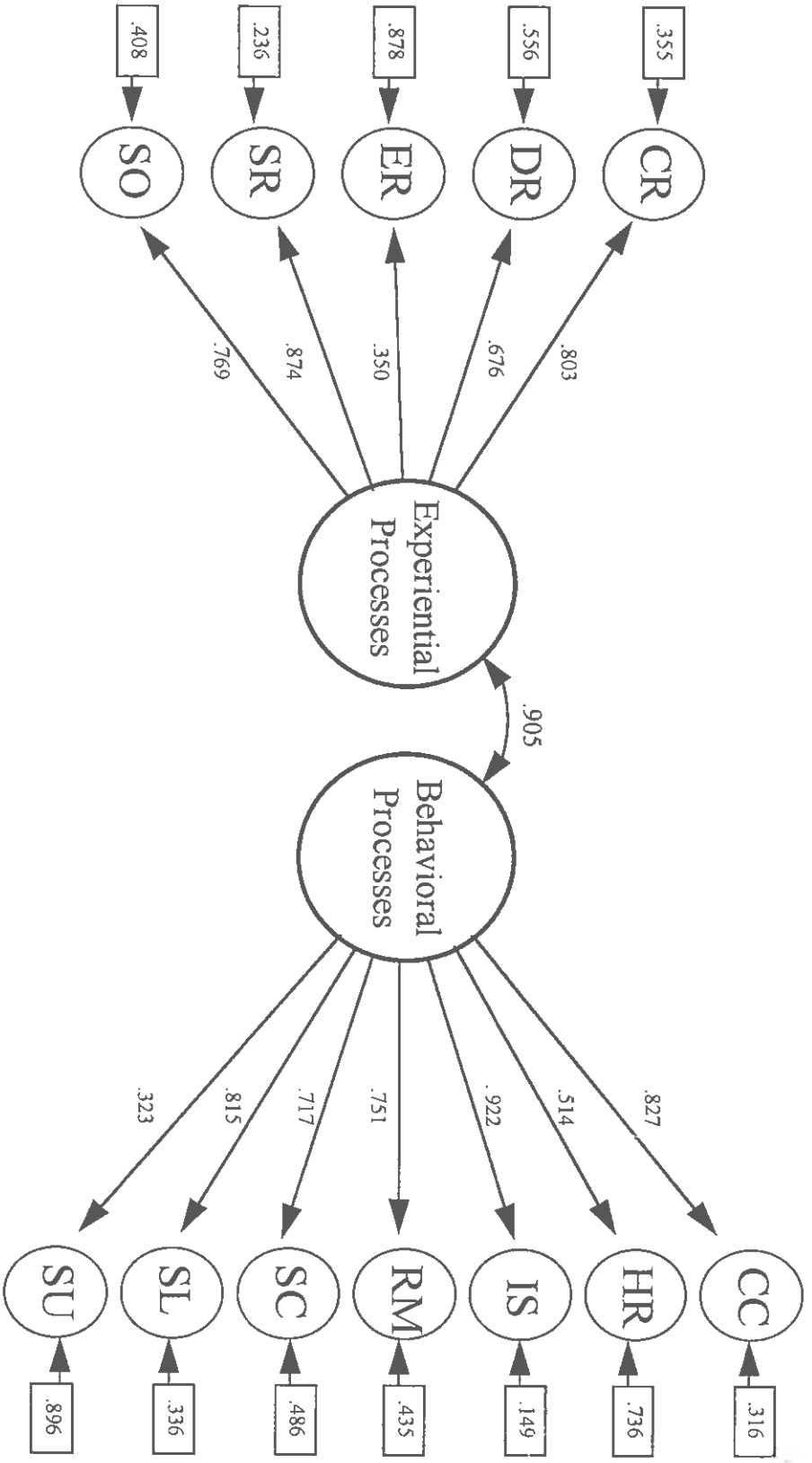
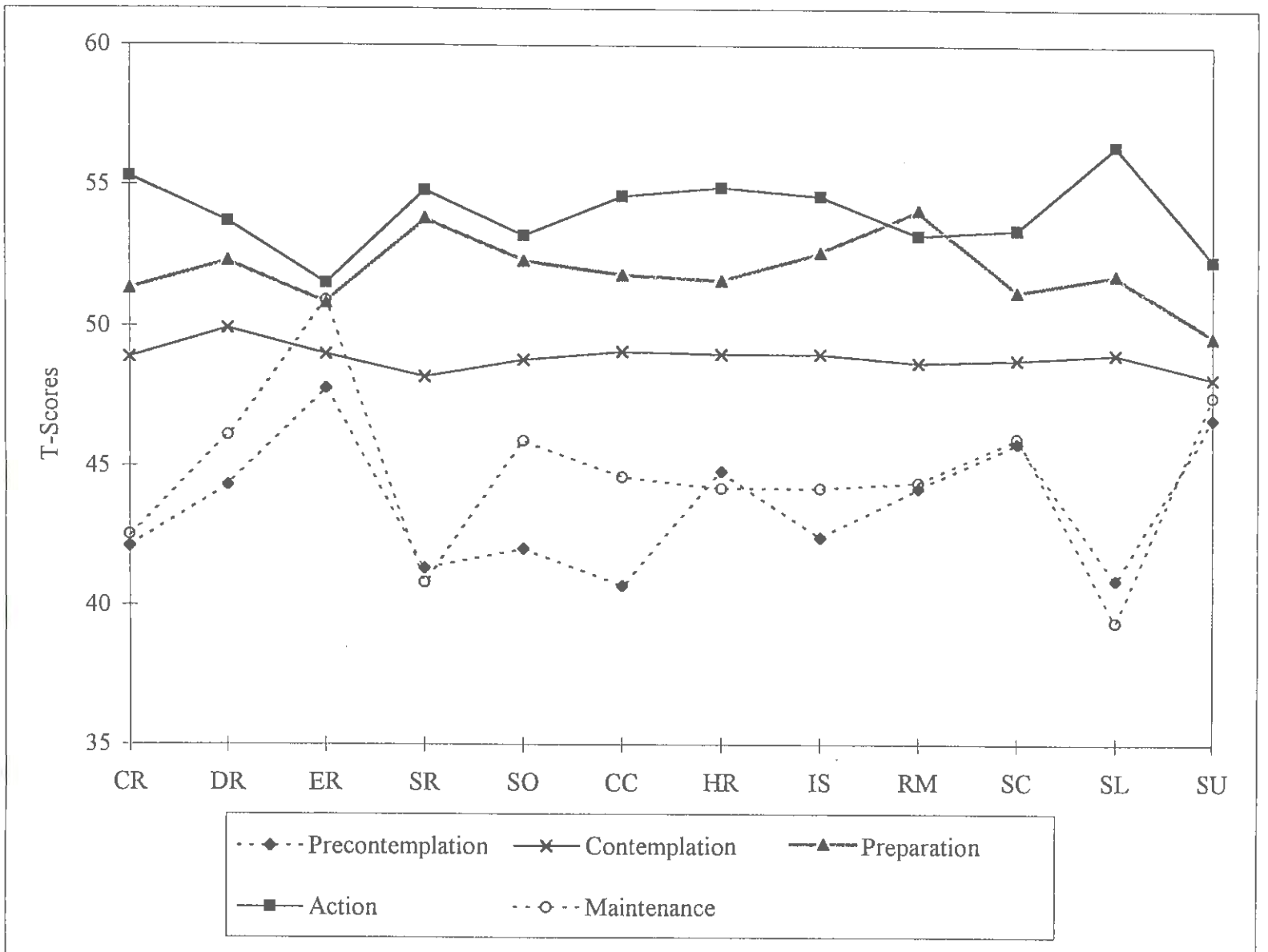

.355
.556
.878
.236
.408
CR
DR
ER
SR
SO
.803
.676
.350
.874
.769
Experiential Processes
.905
Behavioral Processes
.827
.514
.922
.751
.717
.815
.323
CC
HR
IS
RM
SC
SL
SU
.316
.736
.149
.435
.486
.336
.896

Figure 2 Twelve Processes of Change for Weight Control by Stage


60
55
50
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35
T-Scores
CR
DR
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SR
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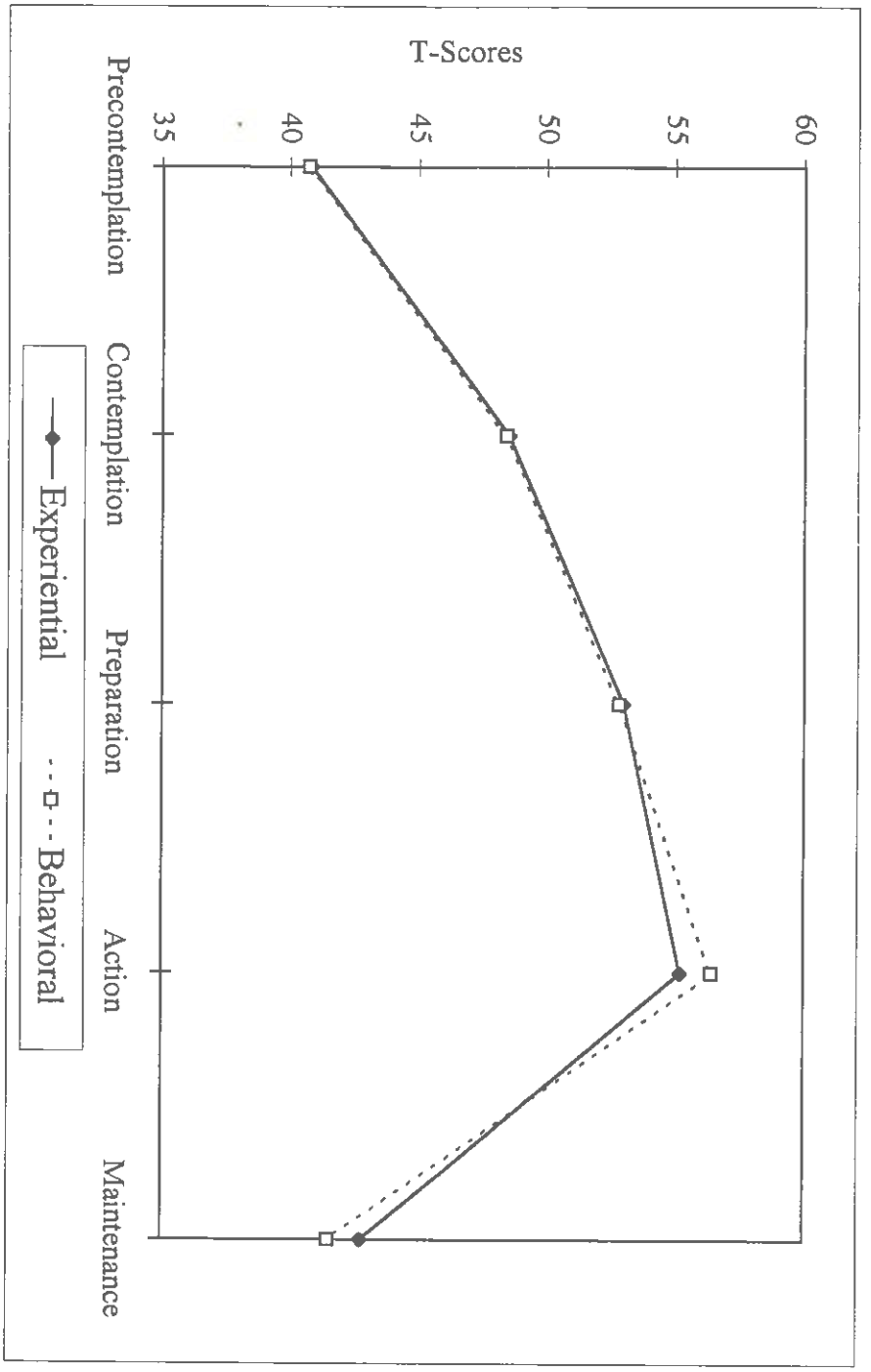
Precontemplation
Contemplation
Preparation
Action
Maintenance

Figure 3 Experiential and Behavioral Processes of Change for Weight Control by Stage


T-Scores
60
55
50
45
40
35
Precontemplation
Contemplation
Preparation
Action
Maintenance
Experiential
Behavioral

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